

expenses of the Centralstelle would be much the same as if he subscribed directly to the Centralstelle (if expenses incurred by the R.A.S. be distributed among the ten subscribers). But the reduction of the telegraphic expenses may be best shown by an example.

On an average twelve telegrams are sent from Kiel per annum with reference to the discovery of minor planets, and a like number with reference to the discovery of comets and other objects of interest; the average number of words in each telegram, exclusive of the address, being about fourteen. It is possible, as Prof. Krueger points out, to subscribe to the Centralstelle for all telegrams, or to have a partial subscription, in which case discoveries of minor planets are not notified. Supposing, then, that twelve telegrams, each of eighteen words (including address), were received during the year, the cost to a direct subscriber to the Centralstelle would be $216 \times 2d. = 1l. 16s.$; but to a subscriber through the R.A.S., if ten subscribers joined, it would be one-tenth of this (or $3s. 8d.$) plus the cost of English telegrams = $9s.$, or $12s. 8d.$ in all—a reduction of $1l. 3s. 4d.$

2. The few German words used could be translated into English. But the telegrams are mainly in cipher.

3. English discoveries, communicated directly to the R. A. S., could be circulated immediately without passing through the Centralstelle.

The disadvantages would appear to be

1. The slight delay in re-distribution with possibility of accident to the main telegram.

2. The extra work and responsibility thrown on the paid Secretary of the Society (or his deputy). In view of these considerations, the Council will be guided in their decision to a great extent by the number of possible subscribers; and it is hoped that those interested will communicate with the Secretaries as soon as possible.

Note on the Lunar Theory. By Ernest W. Brown, M.A.

In determining the coefficients of the inequalities in the Moon's motion, which depend on the eccentricity and the ratio of the mean motions of the Sun and Moon, it is important to have the motion of the perigee of the Moon accurately determined. I have completed the determination of those coefficients which are of the form $e f(m)$, and in particular that part of the evection which is of the above form. The determination of the part of the motion of the Perigee required for this involves the solution of an infinite determinant. In vol. viii. of the *Acta Mathematica* Dr. Hill has, however, found a value for this

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quantity calculated to fifteen places of decimals. This value I have succeeded in verifying as far as nine places of decimals, by proceeding in an entirely different manner. His value is

$$\frac{1}{n} \cdot \frac{dw}{dt} = 0.008572573004864.$$

Using this, the following coefficients in longitude were obtained for those parts which are of the form $e f(m)$:—

$$\begin{aligned} &+ 4607''.9836 \sin(2D-l) + 35''.2200 \sin(4D-l) \\ &+ 0''.2906 \sin(6D-l) + 0''.0028 \sin(8D-l) \\ &+ 174''.8610 \sin(2D+l) + 1''.4460 \sin(4D+l) \\ &+ 0''.0121 \sin(6D+l) + 0''.0001 \sin(8D+l) \end{aligned}$$

These values are all correct to the last decimal given. The notation is the same as in Delaunay's Lunar Theory, and his value of the eccentricity, for purposes of comparison, has been used. The results, however, are adapted for any value of the eccentricity with the given one for the mean motions. It may be stated that Delaunay's value for the corresponding part of the evection in longitude is

$$4607''.7710.$$

I hope before long to publish the complete determination of all the inequalities depending on the eccentricity and mean motions, including that part of the motion of the perigee which depends on the eccentricity of the Moon. This will amount to a general solution in series of Dr. Hill's equations.*

$$\begin{aligned} \frac{d^2x}{dt^2} - 2n' \frac{dy}{dt} + \left(\frac{\mu}{r^3} - 3n'^2 \right) x &= 0 \\ \frac{d^2y}{dt^2} + 2n' \frac{dx}{dt} + \frac{\mu y}{r^3} &= 0 \end{aligned}$$

In this solution the eccentricity of the Moon is left arbitrary.

Haverford College:
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* *Amer. Journ. Math.*, vol. i. p. 129.

Observations of the Spots and Markings on the Planet Jupiter, made at the Dearborn Observatory, Northwestern University, Evanston, U.S.A. By G. W. Hough, Director.

The observations for longitude, latitude, and magnitude of objects on the planet *Jupiter* have all been made with the parallel wire micrometer, preferably near the central meridian, but no rigid rule is followed in this respect. The longitude and latitude are usually determined whenever the spot or marking is wholly on the disc and distinctly visible.

The longitudes are ascertained by measuring the distance of the apparent centre of the object from the two limbs of the planet, according to the method I pointed out some years ago. A determination of longitude or latitude generally consists of three bisections of the object and each limb of the planet. In the case of longitude, one-half of the difference of the distances at the mean of the times is the distance of the apparent centre of the object from the central meridian of the visible disc. This method of determining longitudes has been found to be greatly superior, in point of accuracy, to the method of transits, as well as a great saving of time.

Professor Barnard, of the Lick Observatory, in the publications of the Astronomical Society of the Pacific, No. 5, and in the *Monthly Notices of the Royal Astronomical Society*, 1891 November, on insufficient data, has too hastily assumed that the method of eye estimates, or transits, may be as accurate as micrometer work.

My observations on the planet *Jupiter* with the 18½-inch refractor of the Dearborn Observatory have been continuous since 1879, with the exception of the opposition of 1888 and a portion of 1889, during which period the telescope was dismounted for removal to the new site at Northwestern University.

The great red spot, owing to its long period of visibility, is perhaps the most interesting object on the disc. Since its observation in 1878, *Jupiter* has made a complete revolution in his orbit, and the red spot appears to have preserved its outline, shape, and size with very little change during the whole period.

There has been marked fluctuation, however, in its colour and visibility, the spot at times being so faint as to be invisible with small telescopes.

During the past twelve years a number of observers have asserted at different times that the red spot was connected with, or merged into, a belt in its immediate vicinity. This matter was fully discussed some years ago, and I inferred from what was then said that it was the general opinion of all astronomers who used sufficient optical power, that the spot was at all times separate, although in close proximity to other matter.

During 1889 and 1890 the planet was too far in south declination to afford any definite information. So far as my